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Geopolymers In Ancient Egypt: Are The Pyramids Made Of Faux Stone?

In his 1988 book, *The Pyramids; An Enigma Solved*, (co-authored by Margie Morris) Dr. Joseph Davidovits makes the claim that the pyramids of Egypt are actually made of aggregate and the individual blocks were poured in place. Is this claim reasonable? Could this be the way the pyramids were actually built? In the following essay we will attempt to answer these questions as we examine Dr. Davidovits claim, and compare it with the evidence, as well as with other possible explanations of how the pyramids might have been built.

Dr. Davidovits is a French research chemist, born in 1935 who holds a doctorate from the University of Mainz. In his book he writes that he is the founder of a new branch of chemistry which he named geopolymerization. He states that he holds more than twenty five international patents for geopolymeric products and processes. I suspect that the production of modern faux stone is largely based on his work.

The pyramids of Egypt, especially the Great Pyramids at Giza, have long amazed visitors, and many have wondered how the ancient Egyptians, with the technology available to them, could have erected such tall and massive buildings made of such large blocks of stone, and how they could have shaped the stone blocks so evenly, and laid them with such precision. The most widely accepted theory is that the stone blocks were quarried whole, and dragged up ramps against the pyramids and placed in position. Some say the stone blocks were quarried near by, while others say they were quarried many miles away and dragged overland or floated along the Nile to the site.

The general belief is that the largest pyramids, which are located at Giza, were built about four and a half or five thousand years ago; each one during the rein of a pharaoh, for use as his tomb. The Great Pyramid at Giza is generally held to have been built as a tomb for Pharaoh Khnumu-Khufu, (also known as Cheops) during his twenty three year rein. The pyramid contains approximately two and a half million limestone blocks which weigh from two to seventy tons each. Most of the blocks are a dull colored rough limestone. Originally, the pyramid was covered with casing blocks made of a fine, smooth, shiny white stone. Today, most of the casing blocks are missing, having been removed to construct other buildings. It is generally believed that during the Great Pyramid Building Age, the

Egyptians did not have iron, or even good quality bronze, but only stone tools, and copper, (which is quite soft) as well as some soft copper alloys. Could the the fairly hard limestone which the pyramids are composed of have been quarried and shaped with stone tools, or with tools made from such soft metals? Another problematic question is how the great blocks of stone, weighing anywhere from two to seventy tons in the the Great Pyramid at Giza, could have been transported to the site or moved into position high up on the pyramid. Even if the stone blocks were quarried nearby, they would still have to be moved up the pyramid and placed in position.

The most widely held view of how the stone blocks could have been moved up the pyramid is that great ramps were built against each side of the pyramid and the heavy blocks of stone dragged up them by large gangs of workmen. One problem with this theory is that building the ramps would have been almost as great of an undertaking as building the pyramid itself. Another problem is that the ramp would have to be raised for each tier. In order to maintain the slope of the ramp, it would have to be raised along its entire length; and no more blocks could be dragged into place until this had been done. Because of these difficulties some have have proposed the idea of a wrap around ramp which would wind around the pyramid as it went up.

I don't know of any Egyptian records describing the building of the pyramids, but Herodotus, a Greek historian, visited Egypt around 460 B.C.E and recorded what he was told about the construction of the Great Pyramids , which at the time of his visit were already over two thousand years old. Herodotus could not understand the local language and spoke to the Egyptians through an interpreter. I don't know much Greek, so I am going to use an English translation to quote him. Describing the construction of the Great Pyramid of Cheops (Khufu) he writes, “ This pyramid was built thus; in the form of steps, which some call crosae, and others call bomides. After preparing the foundation, they raised stones by using machines made of short planks of wood, which raised the stones from the ground to the first range of steps. On this range there was another machine which received the stone upon arrival. Another machine advanced the stone on the second step. Either way their were as many machines as steps or their was really only one, and portable, to reach each range in succession, whenever they wished to raise the stone higher. I am telling you both possibilities because both were mentioned.” [Davidovits, pg 158.]

Based on the above account it has been suggested that the Egyptians used wooden derricks and pulleys to build the pyramids. One problem with this theory is the question of whether wooden derricks would have been strong enough to hoist a twenty ton block of stone. Davidovits claims that no evidence of any such devices dating from the Pyramid Age have ever been found in Egypt and further, he claims that such devices were not known in Egypt until the Romans introduced them in the first century B.C.E. Davidovits suggests that the “machines made of short planks of wood” which Herodotus mentions were actually wooden forms for pouring aggregate into.

Another interesting account comes from another Greek historian Diodorus Siculus who visited the pyramids around 21 B.C.E. In his *Historical Library* he writes, (in translation) “ And the most remarkable part of the account is that, though the surrounding land consists of nothing but sand, not a trace remains either of ramps or the dressing of stones, so that they do not appear to have been made by the slow hand of man but instead look like a sudden creation, as though they had been made by a god and set down bodily in the sand. Some Egyptians make a marvel out of these matters, saying in as much as ramps were made with salt and saltpeter, when the river was let it dissolved them and completely effaced them without the intervention of mans hand.” [Davidovits, pg 158.]

Davidovits claims that during quarrying, at least as much stone is lost to damage as is useable, and he makes much of the fact that large quantities of damaged stone blocks have never been found in Egypt. He also notes that the above account speaks of the river being let into the area of the pyramid, which he says would have been done in order to soften limestone for aggregate.

Another theory of how the pyramids were built is that they were built by aliens from another planet using advanced technology or that aliens with advanced technology, working as consultants, helped the ancients with this technical feat. All I am going to say about this theory is that the fact that people have seriously considered it shows just how hard it is to imagine how the ancient Egyptians could have built such monumental structures of hewn stone.

At this point I believe that is time for a more detailed look at Davidovits' theory. Davidovits believes that the stone blocks in the Great Pyramids are actually man made and to back up his claim he provides a workable theory and considerable evidence. Davidovits writes that the technology for making artificial stone is simple. He claims that most of the necessary ingredients are abundant in Egypt. Davidovits says the aggregate consists largely of limestone which is abundant locally. Another major ingredient is water, which is plentiful in the Nile which is close by. Another ingredient is lime, which can be obtained by heating limestone.

Davidovits informs us that a key ingredient of the binder is alumina, which he says is abundant in the Nile River mud. He tells us that another key binder ingredient is natron salt which he says is abundant in the desert and in salt lakes. He explains that natron reacts with lime and water to form caustic soda which he says is the main ingredient for making artificial stone. Davidovits writes that in ancient times the mines in the Sinai were rich in turquoise and chrysocolla (which are needed for the production of synthetic zeolites that are important binder ingredients) as well as the arsenic minerals of olivenite and scorodite which are needed to produce rapid hydraulic setting in large concrete blocks. He claims that the ancient Egyptians are known to have used these same minerals in other processes. Davidovits writes that Egyptologists are well aware that vast quantities of turquoise and chrysocolla were removed from the Sinai mines, but they cannot account for what happened to them.

Davidovits also writes that the ancient Egyptians are known to have made artificial stone. He says that a French chemist by the name of Henry le Chatelier (1850- 1935) made this discovery in the early 1900s while studying enameled Egyptian funerary statuettes from the Thinite epoch. (c. 3000 B.C.E) le Chatelier examined the statuettes using newly developed micrographic techniques, glass slides, thin section analysis, and photography in combination with the microscope, and was astonished to find that what had been previously thought to be natural sandstone was in fact man made artificial stone.

One problem with Davidovits' theory is that although it solves the technical and engineering problems of quarrying and transporting large blocks of stone, there is still the fact that a tremendous amount of rock would have to be crushed into gravel size aggregate. In a modern quarry, explosives along with large amounts of electricity and huge machines are used to do this. Davidovits solves this problem by saying that the limestone at Giza becomes soft when it gets wet. He says canals were dug from the Nile to the limestone deposits and in flood season water was diverted through these canals to flood the limestone and soften it so it could be scraped up with a hoe and used for aggregate. If it is true that the local limestone does indeed become soft when it gets wet, this would solve the aggregate problem, but frankly, I would like to see some proof that this is in fact the case.

Davidovits claims to have found wood grain imprints on a stone sample taken from a protected area in a passage inside the Great Pyramid, which he says is evidence that the stone is in fact concrete which was poured into a wooden mold. He says that the upper several inches in each stone block is spongy and of inferior quality as compared to the rest of the block. He says that this is caused by the water in the forms rising to the top while the aggregate and binder settled to the bottom. He writes that limestone contains fossil shells and that in natural limestone these shells are found laying flat, but in the pyramid stone, the shells are all jumbled, which he says is due to the aggregate being dumped into the mold. Davidovits writes that natural limestone does not contain air bubbles, but that the pyramid stones do. He explains that natural limestone contains horizontal layers, but that pyramid stones do not, but that some of the larger blocks have wavy lines similar to those which are sometimes found in modern concrete and are known as lift lines. He says that lift lines are caused when a pour is interrupted and later finished, as when a crew quits for the day and finishes the pour the next morning. Davidovits tells us that a research team using sophisticated equipment found that the pyramid stone in the Great Pyramid is twenty percent less dense than the surrounding bedrock. He says this is typical of man made geopolymeric stone, and is caused by air bubbles. Davidovits writes that the pyramid stone has a very high moisture content, while the local bedrock is relatively dry. He says that concrete buildings have a high moisture content, and he speculates that blocks in the pyramid, which were soon covered with other blocks, never fully dried. Davidovits relates that he took photographs of a section of a pyramid which contained about two thousand visible stone blocks. He then made slides from the photographs and compared the lengths of the stones, and found that among the two thousand blocks there were only ten uniform lengths, which he says is evidence that they were cast in place with reusable molds. He believes that had the blocks been quarried whole, they would not be of such uniform lengths. He also mentions the paper thin layer of mortar between the pyramid blocks, which he says would be to thin to hold one block to another. He goes on to explain that these paper thin layers of mortar, are a by product of geopolymerization, that form when there is excess water in the slurry; the weight of the aggregate squeezes watery cement to the surface where it sets to form a skin.

From the time of the building of the Pyramid of Zoser (the first pyramid) to the building of the The Great Pyramid of Khufu at Giza, which was the largest pyramid ever built, was only about a hundred years, and within another hundred years, pyramid building had gone into decline. Why this decline happened has long been a mystery, but Davidovits claims to have the answer: he says that pyramid building went into decline because some of the necessary minerals for making artificial stone, which had been mined in the Sinai, were exhausted.

Another point which Davidovits makes is that when the Ancient Egyptians did not yet have hard metals they built huge pyramids containing millions of perfectly shaped blocks of fairly hard limestone, but once they had hard bronze and iron, they quit using limestone, and almost exclusively used very soft sandstone. If we believe that the stone blocks for the Great Pyramids were quarried whole, this doesn't make much sense; but if we believe Davidovits' theory, it makes perfect sense.

Most Egyptologists, and archaeologists do not accept Dr. Davidovits' theory, although in recent years his idea has started to gain some traction, and a few other people working in the field have come out with similar theories.

So is Dr. Davidovits' theory reasonable? Is it correct?
In my opinion, his theory is reasonable. It solves some difficult questions which other theories have never been able to satisfactorily answer.
Ah, but is it correct? Well, truth to tell, I can't answer that question with the data I have available to me; I would have to train in geology, and geopolymerization, and then go on site with the proper equipment, and carefully examine the pyramids and the quarries; and then carefully analyze the data before I would be in a position to say.
But perhaps your interest has been piqued; maybe some day you will answer the question.

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